The Canadian Entomologist

LXVI ORILLIA, JANUARY, 1934 No. 1

STONEFLIES FROM THE PURCELL RANGE, B. C.

BY FERRIS NEAVE,
University of Manitoba, Winnipeg, Man.

The Purcell Range forms the easternmost portion of the Selkirk Mountains. It runs nearly north and south and is well marked off from other mountain ranges by the Rocky Mountain Trench on the east and the Purcell Trench on the west. The latter is occupied in part by Kootenay Lake. Even the broad geography of this range is imperfectly known as yet and its entomological resources are practically unknown. Three well-known entomologists, H. G. Dyar, A. N. Caudell and R. P. Currie spent much of the summer of 1903 in the Kootenay district with headquarters at Kaslo (Currie 1904). Most of their collecting was done on the west side of Kootenay Lake but several brief visits were paid to the mouths of creeks entering the lake from the east and thus belonging to the Purcells. One or two other collectors may have done the same. The present writer collected a few insects during visits to the range in 1928 and 1929 but otherwise this great tract of wild country is entomologically unknown.

It was therefore with great interest that I examined a collection of stoneflies made by my brother, Roger Neave, in May and June, 1933. The specimens were collected along or near to the course of Campbell Creek, which rises near the crest of the Purcell Range and discharges into Kootenay Lake. The elevation of the latter is 1,760 feet. The highest point from which specimens were collected was 7,000 feet, making a vertical interval of over 5,000 feet and thus giving a good cross-section of the country. Campbell Creek itself runs about 10 miles in an east to west direction, is very rapid throughout its course and flows through a short canyon close to the lake. It is non-glacial in character but greatly swollen at times by melting snows. A few of the stoneflies captured near the summit of the range belonged to the Fry Creek system. Fry Creek also discharges into Kootenay Lake, about 8 miles north of Campbell Creek. It runs through similar country but differs from Campbell Creek in being fed by glaciers, and therefore contains a much greater quantity of silt.

Among other interesting material the collection yielded a striking new genus (*Megaleuctra*) and established *Eucapnopsis* Okamoto as an American genus. A new species of *Leuctra* and the hitherto unknown nymph of *Kathroperla* also turned up.

In addition to a few females of *Nemoura* which cannot be identified at present, the collection included the following:

PERLIDAE

Perlodes irregularis Banks. Campbell Creek, 27.VI, 3,000'-5,000', female. Nymphs of a *Perlodes*, taken in Campbell Creek in May and June may belong to this species, but *P. bradleyi* Smith is recorded from Kaslo. They resemble *P. tibialis* in the distribution and number of the gills (Claassen 1931), but show certain differences in the mouthparts, as follows: maxillary and labial palps

longer; galea apparently only 1-segmented; glossal angles acute; paraglossae more slender. On the dorsal side of the head, inwardly from each eye, is an oval pale patch with a reticular pattern formed from short brown hairs.

Alloperla borealis Banks. Campbell Creek, 20.V-27.VI, 2,700'-6,500', males and females. Also a female from 10-mile Creek, Kaslo, 15.V.

Alloperla serrata Needham and Claassen. Campbell Creek, 27.VI, 3,000'-5,000', female.

Paraperla frontalis Banks. Campbell Creek, 23.V, 2,700', male; Fry Creek trib., 18.VI, 5,700'-7,000', female.

Kathroperla perdita Banks. Campbell Creek, 20.V-12.VI, 2,700'-6,500', 6 males, 4 females. Kaslo is the type locality for this species, which has very seldom been found. A nymphal skin was collected together with adults on 24.V. (2,700').

Nymph. Length of body 18 mm. Cerci 8 mm. Body cylindrical, slender, brownish, apparently without striking colour markings. Head very long, eyes far forward as in adult. Gills absent. Prothorax transversely oval; prosternal humps prominent. Tenth abdominal tergite broadly rounded. Cerci of about 24 segments. Posterior angles of head with a tuft of coarse hair. Disc of pronotum fringed with conspicuous coarse hairs. Posterior margins of abdominal segments fringed with similar hairs. The mouthparts, while conforming to the general carnivorous Perlid type, differ considerably from *Paraperla*, usually regarded as the closest ally of *Kathroperla* (plate 1, figs. 1, 2, 3). The mandibles are sharply toothed and bear inwardly a fringe of hairs. The lacinia of the maxilla is very broad, with a long, curved terminal tooth. The latter is without subsidiary tooth or hairs but is followed by the usual fringe of stout hairs, which are strongly developed. The galea reaches only to the base of the lacinial tooth. The third and fourth segments of the palp are subequal in length, the fifth much shorter and narrower. The submentum of the labium is very long, with prominent shoulders; the paraglossa large and broad, reaching far beyond end of hypopharynx, each bearing a row of slender bristles on its ventral surface. Terminal segment of labial palps very long and slender.

Peltoperla sp. Campbell Creek, 2,500'-3,000', nymphs.

NEMOURIDAE

Nemoura frigida Claassen, Campbell Creek, 11.VI, 2,500'-3,000', male. Previously known only from Claassen's type, a male taken at Sitka, Alaska, 16.VI. 1899.

N. columbiana Claassen. Campbell Creek, 30.V, 5,000'-6,500', females; also 10-mile Creek, Kaslo, 15.V, 2,700'.

N. delicatula Claassen. Campbell Creek, 29.V, 1,760'-2,700', male and female. Needham and Claassen (1925) record this species only from Boulder, Colorado.

N. cinctipes Banks. Campbell Creek, 30.V, 5,000'-6,500', females.

Leuctra bradleyi Claassen. Campbell Creek, 12.VI, 3,400', male; 14.VI, 5,000'-6,500', male. The only published record is of the holotype, taken at Emerald Lake, B. C.

L. occidentalis Banks. Campbell Creek, 30.V, 5,000'-6,500', both sexes.

Leuctra purcellana sp. n.

Male. Length to tip of wings 6.5 mm. Expanse 11 mm. Dark brown.

CAN. ENT. VOL. LXVI. PLATE I.

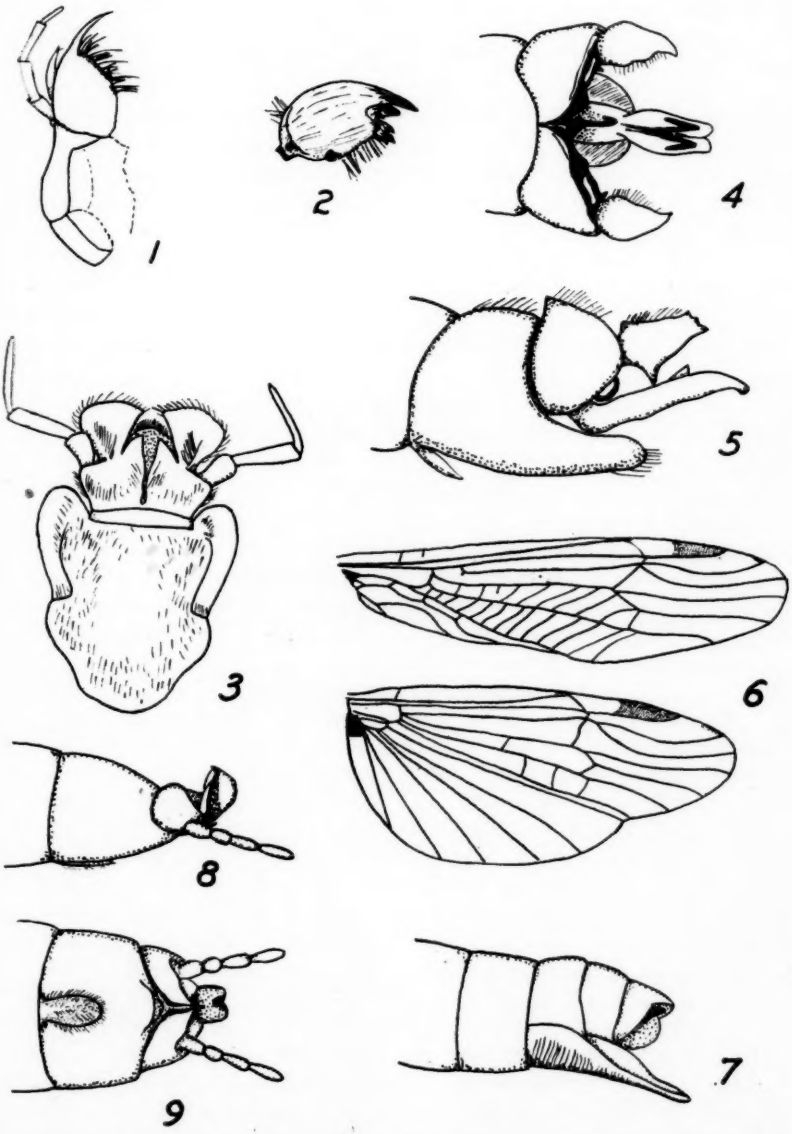


Fig. 1—*Kathroperla perdita*, nymph, maxilla; 2—mandible; 3—labium, ventral view. Fig. 4—*Leuctra purcellana*, male, tip of abdomen, dorsal view; 5—lateral view. Fig. 6—*Megaleuctra spectabilis*, female, wings; 7—tip of abdomen, lateral view. Fig. 8—*Eucapnopsis brevicauda*, male, tip of abdomen, lateral view; 9—ventral view.

Head wider than prothorax. Prothorax wider than long, median longitudinal field about one-quarter the width of pronotum. Two Cu crossveins beyond M-Cu series. Legs brown, the greater part of the tibiae and the first tarsal segments slightly paler than the rest. Tenth abdominal tergite cleft, each portion with a small triangular projection near the middle line and a small tooth near base of cercus. Cerci sclerotised, resembling those of *occidentalis* Banks but the ventral tooth is shorter and the tip of the cercus, as seen from the side, is truncate, bearing three small teeth. Supra-anal lobe produced into a narrow black, sickle-shaped process which curves upward above the base of the probe. Subanal lobes forming a probe which is shorter than that of *occidentalis*. Ninth sternite produced into a plate, rounded at the tip, which reaches to the end of the abdomen. Ventral lobe short, truncate at tip. (Figs. 4 and 5.)

Holotype, male, Campbell Creek, 14.VI.33, 5,000'-6,500' (R. Neave), in the writer's collection.

Female unknown.

Taeniopteryx (*Taenionema*) *nigripennis* Banks (?) Campbell Creek, 30.V, 5000'-6,500', female.

T. (*T.*) *pacifica* Banks (?) Campbell Creek, 12.VI, 3,400', female.

T. (*Doddsia*) *occidentalis* Banks. Campbell Creek, 11.VI, 2,500'-3,000', 3 females.

Megaleuctra gen. n.

Second tarsal segment short. Cerci consisting of one segment (female). Wings involute, anal field of hind wings large. Subcosta runs out nearly to costal margin, then bends down and meets radius at the cord. M-Cu and Cu crossveins very numerous, extending beyond the cord. Second anal vein forked. Female with 8th and 9th sternites produced to form a long ovipositor.

Genotype, *Megaleuctra spectabilis* sp. n.

Megaleuctra spectabilis sp. n.

Female. Length to tip of wings 17-18 mm. Expanse 29-30 mm. Antennae and palps dark brown. Antennae of 55 to 60 segments. Head brown with dark markings on clypeus and immediately in front of anterior ocellus. Tubercles dark and occiput with dark mottlings. A depression between the posterior ocelli. These latter more than twice as far apart as distance of each from eye. Prothorax slightly widened behind, brown with a dark central area, the dark colour spreading out towards the four corners. Femora dark brown, also base and extreme apex of tibiae and last tarsal segment. Rest of legs paler. Wings with heavy brown veins. Both fore and hind wings with a conspicuous dark brown area in the distal portion of the pterostigma and traces of the same colour along the costal margin at end of Sc and Rs_1. Subcosta almost touching costa before bending back to meet radius at the cord. No costal crossvein beyond end of subcosta. R_1 ends considerably before tip of wing. Crossveins in median and cubital regions of forewing numerous, extending beyond the cord,—9 or 10 in the M-Cu series, 13 or 14 in the Cu series. Sometimes one or two extra crossveins between cubitus and first anal. Anal field of hindwing large, with 6 veins. (Pl. 1, fig. 6.) Cerci very small, one-segmented. Eighth and 9th sternites greatly produced downward and backward, together forming a long ovipositor-like structure extending beyond the tip of the abdomen and

quite unlike any other stonefly with which I am familiar. (Pl. 1, fig. 7.) The portion belonging to the 8th sternite is concave above, forming a sheath for the reception of the prolongation of the 9th sternite.

Holotype, female, Campbell Creek, 29.V.33, 1,760'-2,700' (R. Neave), in the writer's collection.

Paratypes, one female, same data as holotype; one female, Campbell Creek, 11.VI, 2,500'-3,000'; one female, Fry Creek trib., 18.VI, 5,700'-7,000'.

The discovery of this very interesting species seems to add considerable confirmation to the views of Tillyard (1921) and of such American authorities as Banks, Needham and Claassen, who have refused to rank *Nemoura, Leuctra-Perlomyia* and *Taeniopteryx* (*sens. lat.*) as separate families. European systematists, as represented by Klapalek, Schoenemund and others, have for many years recognized the *Nemouridae*, *Leuctridae* and *Taeniopterygidae*. The following table indicates the chief points of distinction between these three groups and the position of *Megaleuctra* in these respects.

	Tarsal segs.	Wings at rest	Anal field of hindwing	Crossvein(s) beyond Sc	Cerci (female)
Nemoura	2nd short	flat	large	present	one seg.
Leuctra	2nd short	involute	small	absent	one seg.
Taeniopteryx	all sub-equal	involute	large	present or absent	several segs.
Megaleuctra	2nd short	involute	large	absent	one seg.

It is thus seen that *Megaleuctra* combines several important characters of the other groups. In some other respects, e.g. the numerous crossveins in the forewing and the extraordinary egg-laying apparatus of the female, it is entirely distinct from any of them.

CAPNIIDAE.

Eucapnopsis Okamoto

This genus was formed by Okamoto (1922) for the reception of two new Japanese species. He separated them from *Capnia* on the strength of the short cerci, the structure of the subgenital plate and certain points in the venation. In 1924 Claassen described a species with short cerci from Boulder, Colorado, as *Capnia brevicauda*. The male was unknown. Needham and Claassen (1925) retain his species in the genus *Capnia*, remarking (p. 269), "Okamoto has recently made a new genus (*Eucapnopsis*) for the species with short cerci, however the venation and other characters are typical of *Capnia*."*

The discovery of the male of Claassen's species in the Campbell Creek collection brings up the question again. It differs from all the described North American Capniidae and agrees with Okamoto's species in possessing a ventral lobe at the base of the 9th sternite. Taken in conjunction with the short cerci, this feature may well indicate Nemourid affinities and in my opinion certainly

*In the list of species (loc. cit., p. 288) *Eucapnopsis* is given as a subgenus, but, evidently by a slip, *C. vernalis* Newport is placed under it.

entitles these forms to generic rank. The male genitalia (pl. 1, figs. 8 and 9) and the venation (see Needham and Claassen, pl. 47, fig. 2) in some respects are not unlike certain Nemouridae,—at any rate they are not of the most extreme Capniid type.

Eucapnopsis brevicauda (Claassen)

Male. Length to tip of wings 5-6.5 mm. Expanse 9-11 mm. Coloration, etc., as in the female. The cerci have from four to six segments. Ninth sternite bearing a lobe which is about twice as long as wide, rounded at the tip and beset with hairs. The same sternite has a transverse, crescent-shaped ridge close to its distal edge. Each subanal lobe is strongly sclerotised along its median edge, which is produced posteriorly into a sharp spine. Supra-anal process upcurved, hood-like, grooved posteriorly and with a black sclerotised edge (figs. 8 and 9). Campbell Creek, 20.V, 2,700′, 3 males, 3 females. Both male and female appear to be exceedingly close to *E. 4-segmentata* Okamoto from Japan, if, indeed, they be not identical with it. As Okamoto, however, does not describe the supra-anal process nor figure it in dorsal or lateral view, a detailed comparison is not possible.

REFERENCES

Claassen, P. W. 1923. New Species of North American Plecoptera. Can. Ent. 55, 257-263 and 281-292.
1924. New Species of North American Capniidae (Plecoptera) Can. Ent. 56, 43-48 and 54-57.
1931. Plecoptera Nymphs of America. Thomas Say Found.
Currie, R. P. 1904. An Insect-Collecting Trip to British Columbia. Proc. Ent. Soc. Wash. VI, 24-37.
Needham, J. G. and P. W. Claassen, 1925. Plecoptera of North America. Thomas Say Found.
Okamoto, H. 1922. Zweiter Beitrag zur Kenntnis der Japanischen Plecopteren. Bull. Agric. Expt. Sta., Chosen, I, 1-46.
Tillyard, R. J. 1921. A New Classification of the Order Perlaria. Can. Ent. 53, 35-43.

LIFE HISTORY AND HABITS OF THE PIGEON LOUSE[1] (COLUMBICOLA COLUMBAE [LINNAEUS]).

BY MARGARET MARTIN,
The Rice Institute, Houston, Texas.

INTRODUCTION.

Very little work has been done on the life history or habits of Mallophaga. Only two papers have been published[2] since 1913 which give even a general discussion of the life history of these parasites. The number of instars through which the insects pass was not determined in either case. For the experiments reported in this paper, the pigeon louse (*Columbicola columbae* [Linnaeus]) was chosen because of the ease of obtaining and handling the common host, *Columba livia* Linn.

ACKNOWLEDGEMENTS.

Before proceeding further, the writer wishes to express her thanks to Dr. M. A. Stewart, under whose direction this work was done, for frequent suggestions and encouragement. Thanks are also due Dr. F. H. Wilson of Tulane University for a number of determined specimens of various species

1. Contribution from the Department of Biology, The Rice Institute, Houston, Texas.
2. Notes on the Life History and Habits of Mallophaga—B. A. Barber, Pprs. Mich. Acad. Sci. 1921, pp. 391-395.
Some External Parasites of Poultry—G. W. Herrick, Cornell Univ. Coll. of Agric. Bul. 359, Apr. 1915.

and for the use of his unpublished thesis on Mallophaga, as well as for his many valuable suggestions. I also wish to thank Mr. H. C. Matthes of Rice Institute for the collection from time to time of the pigeon host.

TECHNIQUE.

Live specimens of *Columbicola columbae* were collected from freshly killed pigeons according to the method developed by F. H. Wilson (1928). The birds were wrapped in cotton and, since most external parasites leave the host when it becomes cold, the lice migrated to the cotton through which they could make little or no progress. Specimens were also collected from live birds, the birds being etherized and the feathers on which the lice were found clipped. By keeping pigeons in captivity, a constant supply of adults was assured.

The lice were kept in an incubator at 37°C. (±.5° to 1°) which was found to be the most favorable temperature for this species. Temperatures ranging from 33°C. to 42°C. were tried. Oviposition occurred infrequently at the various temperatures and the resulting nymphs died within a few days after hatching. A water surface of 12.5 inches square was exposed on the floor of the incubator to provide the necessary humidity. The lice were placed on feathers from the breast region of the bird and kept in open petri dishes. Several unsuccessful attempts were made to rear the lice in capsules attached to the skin of the bird's back, one feather being enclosed in the capsule, but the bird always succeeded in loosening the capsule, thus allowing the lice to escape.

Specimens for microscopic study were preserved by being cleared in 10% KOH, completely dehydrated in a series of graduated alcohols, transferred to clove oil and mounted in Canada balsam. This method, however, could not be used to preserve the soft-bodied nymphs; for these, it was necessary to reduce the clearing agent to a 5% solution and, besides the alcohols, momentary immersion in ether was used to complete dehydration. The rest of the process was completed as above.

SYNONYMY.

The original name of the species under discussion was *Lipeurus columbae*, described by Linnaeus in 1758. According to Harrison (1916-1917), a synonym was created by Nitzsch in 1866 when he described the species as *Lipeurus baculus*. In 1916, Harrison created the genus *Esthiopterum* for certain species of *Lipeurus* including *L. columbae*. The genus *Esthiopterum* was sub-divided by Ewing in 1929 and the genus *Columbicola* was created, in which was included *Esthiopterum columbae*. The valid name of the species is therefore *Columbicola columbae* (Linnaeus).

HOST LIST

Columbicola columbae is common on both wild and domestic pigeons (Columba spp.). It has been reported from "nineteen of the forty pigeon host species" (Herrick, 1915). It has been reported from domestic pigeons all over the United States (and apparently is common in Europe); from the Canal Zone, Panama; from the province of Shinano, China; and from Calcutta, India. It has also been reported from the Chinese turtle dove, *Streptopelia* (Turtur) *chinensis* Ingram, and the Formosan green pigeon, *Sphenocercus formosae*, both of Formosa.

It was reported from the Common Noddy, *Anous stolidus* Linn., of the Galapagos Islands; from *Geospiza fuliginosa* Gould and *Camarhynchus pallidus* Sclater and Salvin (*C. productus*), both Galapagos finches; and from *Nesomimus melanotis* Gould, the Galapagos mocking bird. Considerable interest may be attached to these latter reports, which were made by Kellogg and Kuwana (1902), due to the fact that Mallophaga are coming into use as a means of determining the phylogenetic relationships of birds.

HIPPOBOSCID CARRIERS OF MALLOPHAGA.

Eleven authentic records of Hippoboscids being found with Mallophaga on them have been recorded through 1927. Most of these records are for *Ornithomyia avicularia* Linnaeus. Six of the Mallophaga recorded were of the genus *Degeeriella*, one of the genus *Philopterus* and the others were not determined.

While collecting lice from pigeons, the writer also collected at different times four Hippoboscid flies which were determined as *Pseudolynchia maura* Bigot. One of the flies was carrying three specimens of *Columbicola columbae*, two females and one male. Another fly was carrying one male. It may be seen from this that, since the fly is not confined to one bird during its entire life, *Pseudolynchia* may be, and probably is, an important agent in the dispersal of *C. columbae*.

FEEDING HABITS.

The feeding habits of Mallophaga have not been studied to any great extent. It is generally conceded in textbooks of entomology that they feed on feathers, scales of skin and dried blood. Waterston (1926) writes: "Nothing seems to come amiss to the Mallophaga as food. The protecting sheaths of growing feathers, feather fibre, down, skin, scurf, scabs, blood (when available), etc. are all eaten; they devour, too, their own egg shells, and cast off skins and perhaps occasionally indulge in cannibalism, for I have recently examined a crop of the large *G. bicuspidatus* which was crammed solely with fragments of *Goniocotes diplogonus*, some of which appeared not to be of exuvial origin."

I have never observed *Columbicola columbae* to feed on anything other than the barbules of the feathers, except in one case. A nymph in the first instar was placed on a white feather with a drop of blood smeared on the fluffy part. On the following day the alimentary tract of the nymph was a dull red, the insect evidently having fed on the blood. This specimen died two days later. Six other nymphs were placed on a fresh feather with blood but none of them fed on the blood over a period of seven days. Two nymphs placed on a blood clot in a petri dish died the following day without having fed.

A male was placed on a fresh epidermal scale taken from a pigeon. This specimen failed to feed during an hour but, when placed on a feather, fed at irregular intervals over a period of twenty minutes. Two newly hatched nymphs placed on epidermal scales died without having fed.

Nymphs in all stages of development and adults may be observed feeding frequently on the barbules, nearly always those near the proximal end of the feather. There seems to be a decided preference for the feathers from the breast region of the bird when the lice are raised in the incubator, though they are rarely found in that region on the bird. Where both types of feathers are available in the dish, the lice migrate to the fluffier feathers, only occasionally

CAN. ENT. VOL. LXVI. PLATE 2.

Fig. 1

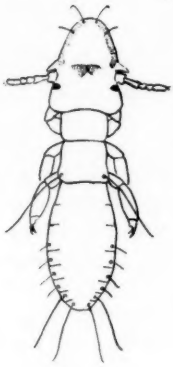


Fig. 3

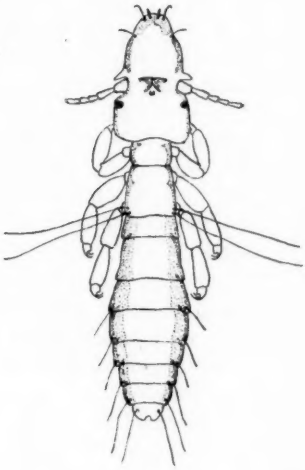


Fig. 4

Fig. 2

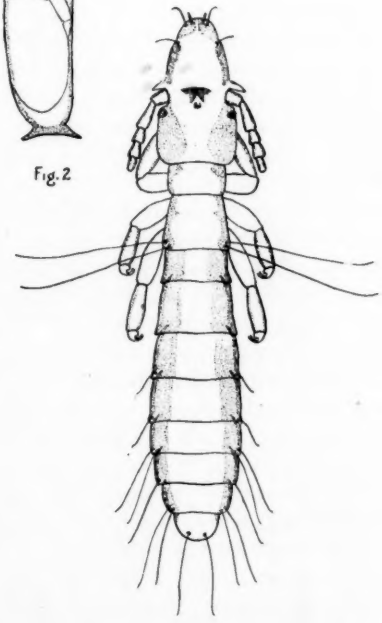


Fig. 5

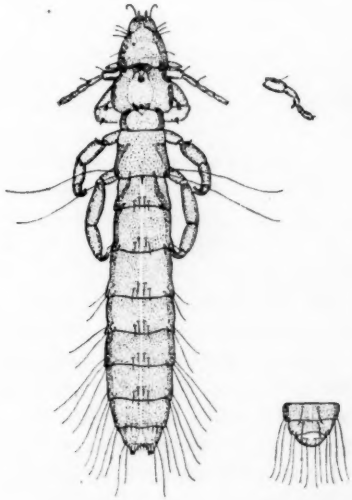


Fig. 6

Fig. 1—Egg of *Columbicola columbae*. Fig. 2—Egg, showing nymph in position shortly before hatching. Fig. 3—Nymph just emerged from egg. Fig. 4—Nymph just after first molt. Fig. 5—Nymph just after second molt. Fig. 6—Adult female; also antenna and posterior abdominal segments of male.

Stippling indicates parts darkened by chitinization. All figures drawn to scale except Fig. 6, which is drawn to half scale.

returning to the stiff flight feathers. The adults are commonly found on the long flight feathers of the bird's wing; the nymphs (and occasional adults, most of which are females) are found on the feathers at the back of the head.

COPULATION.

Mating occurs frequently and may be observed at almost any time. The process is easily seen with a binocular microscope. The male may be observed to approach a quiescent female and clasp her abdomen at the third or fourth segment with his antennae. After a few moments he moves up, taking his position beneath the female, clasping her pterothorax just in front of the coxae of the third pair of legs and curving the end of his abdomen up to meet hers. Coition is interrupted every two or three minutes at which times the male would retreat a little, again clasping the third or fourth abdominal segments of the female with his antennae. If the pair were touched by other individuals, this procedure was almost invariably repeated. The female usually defaecates at the end of fifteen to twenty minutes, the male at twenty-five to thirty minutes. There are periods of several seconds of rest during which the male remains with his antennae clasping the pterothorax of the female. Coition lasts for varying lengths of time, the shortest observed time being about ten minutes and the longest being one hour and fifteen minutes. Frequently, a male may be observed to approach a quiescent female and clasp her abdomen with his antennae; then, though she makes no move to escape, he may release her and move on.

While mating, the female rarely moves unless it is to free herself from the male. In doing this, she runs rapidly in and out among the fluffy barbs near the proximal end of the feather. The male, while still clasping the female around either the pterothorax or abdomen with his antennae, is at a disadvantage and is usually dislodged within thirty seconds to two minutes.

OVIPOSITION.

Oviposition occurs even when the lice are removed for observation from the incubator to the somewhat cooler atmosphere of the room. The egg is plainly visible within the female's abdomen about forty-five minutes before oviposition occurs. It extends from the third to the fifth abdominal segments. As oviposition begins, the female grasps the feather firmly with her mandibles and legs. The tip of the abdomen is raised to about a 45° angle but is lowered as soon as the egg begins to appear. The egg is extruded until all but the tip is exposed. The female then releases her hold on the feather and moves actively about until the egg is released. In the incubator the eggs are usually found in the dish. If they are attached to the glass, they are usually erected at a 40° to 50° angle. In at least 50% of the cases, the eggs were not cemented to anything but were lying loose in the dish. In only a very few instances were the eggs glued to a feather in the incubator. The female shows little preference in placing the eggs when ovipositing on feathers in the incubator. Eggs collected from the pigeon, however, show a definite arrangement. They are always found on the feathers on the underside of the wing, principally on the long flight feathers though some are found on the lesser wing coverts. The eggs lie on the side of the feather next to the bird's body in the deep grooves formed by the barbs, the proximal end being glued against the shaft. The operculum is pointed toward the edge of the feather. Numerous eggs are laid on the same feather, there being from ten to twenty eggs on the feathers of birds with average infestations. As many

as sixty eggs have been found on a single feather.

Over a period of five days, seventeen females laid forty-four eggs, averaging .52 eggs per day per female. In another count, six females laid twelve eggs over a period of six days, averaging .33 eggs per day per female. Nine females laid seventeen eggs during six days, averaging .31 eggs per day per female.

HATCHING.

The process of hatching in *Columbicola columbae* is easily observed under the medium power objective of a compound microscope. The nymph, when ready to emerge, begins pumping in air through the mouth. The air bubbles accumulate in the digestive tract until pressure forces them into the egg shell at the posterior end. After about five minutes, the pressure behind the nymph is sufficient to cause the operculum to burst open. The air pumping is slowed somewhat for six to eight minutes until the second pair of legs is nearly freed. It increases in rapidity for a minute or two and then slows again. The freeing of the rest of the body is aided by muscular contraction and expansion of the abdomen. The head, which in the embryo is folded against the ventral aspect of the thorax, is erected twelve to fifteen minutes after the cap is burst, at about the same time that the second pair of legs is freed. The third pair of legs is freed two to three minutes later. Within another five minutes, the caudal hairs are freed and the egg-shell is left. Immediately upon hatching, the nymph readily grasps a feather and moves actively about. Feeding does not take place, however, until several hours later.

METAMORPHOSIS.

There are three instars in the development cycle of *Columbicola columbae* and three molts occur before the insect reaches the adult stage. (For the length of time elapsing between the molts, see Table I). In the course of these experiments, only three of the specimens collected soon after hatching were reared to maturity. Two of the specimens were females and one was a male. The length of the egg stage for these lice is not known, the eggs from which they developed having been collected from the bird.

Data for the second and third instars as recorded in Table I were obtained almost entirely from nymphs in various stages of development collected from the host and reared in the incubator.

The egg (Fig. 1) is white and, when first laid, is opaque. Later, the embryo can be plainly seen within (Fig. 2). When the egg is laid, it is cemented at the proximal end, the distal end being free and erected. Frequently, as mentioned above, the egg cement hardened before it came into contact with anything. The egg shell is fairly resistant and can withstand considerable pressure.

When first hatched, the young nymph (Fig. 3) is white, the only chitinized area being the mandibles. By the time the nymph is a day old, the clypeal band is a pale yellow due to slight chitinization. Segmentation of the abdomen is very indistinct. The insect at this stage in its development is very active. It feeds frequently and the ingested material can be plainly seen, through the pale cuticula, lying in the crop. The flattened spine on the clypeal margin, which is an important distinguishing character of the genus, is not present in the first instar. A dark eyespot is present immediately posterior to the first antennal

segment.

In the second instar (Fig. 4), the flattened spine is present on the clypeus. The head is well chitinized, as are the antennae and pleurites of both the thorax and abdomen.

In the third instar (Fig. 5), the head, antennae, thorax and abdominal pleurites are well-chitinized, as are the tarsi and claws. After the third molt, the insect reaches the adult stage and the eyespot is no longer present. The process of molting was not observed for any of the instars.

The adult (Fig. 6) is heavily chitinized except for a narrow mid-dorsal line on the abdomen. The antennae are different in the two sexes. The male has a short appendage on the third antennal segment, the antennae being adapted for clasping the female while mating.

Measurements for the various stages will be found in Table II. In order to increase as much as possible the accuracy of all data, the Gaussian formula for calculating the probable error was used. The formula is as follows: P.E.$=\pm.6745\text{x}\ \frac{\delta}{\sqrt{n}}$ where δ is the standard deviation and n is the number of samples used. Where less than sixteen samples are used, the Bessel formula is more nearly correct (Wardle, 1929): P.E.$=\pm\ \frac{.6745\text{x}\delta}{\sqrt{n-1}}$

CONCLUSION.

The life cycle of *Columbicola columbae* may be summarized as follows: The egg stage usually lasts 4.15 days with a probable error of ±.103 days. The average length of the first instar is 6.73 days with a probable error of ±.076 days. The second instar average was 6.72 days with a probable error of ±.064 days. The third instar averaged 6.77 days with a probable error of ±.025 days. These averages are fairly accurate as may be seen by comparison with the data of the three life cycles which were completed. In these completed cycles, the first instar was seven days for all three specimens. The second instar for the females was six and eight days, and for the male six days. The third instar for the females was seven and eight days, and for the male six days.

The metamorphosis of *C. columbae* is greatly slowed by a reduction of 4°C. in temperature. This was demonstrated by the fact that, whereas the egg stage at 37°C. was normally from three to five days, at 33°C., it ran from nine to fourteen days. At the latter temperature, the nymphs nearly always died in from one to six days, though the adults lived as long as twenty-nine days. Two females lived fifty-one days at 37°C., the usual time being from thirty to forty days. Temperature is probably, therefore, the chief factor in determining not only the length of the life cycle but also the percentage of survival of the young.

BIBLIOGRAPHY

Ewing—1929, Manual of External Parasites, p. 116.
Harrison—1916-17, Parasitology, IX, p. 132.
Herrick—1915, Cornell Univ. Coll. of Agri. Bul. 359, Apr., p. 249.
Kellogg and Kuwana—1902, Proc. Wash. Acad. Sci. IV, p. 478.
Linnaeus—1758, Syst. Nat., p. 614.
Nitzsch—1866, Giebel, Zeit. f. ges. Nat. XXVIII, p. 379.
Wardle—1929, Problems of Applied Ent., p. 39.
Waterston—1926, Proc. Zool. Soc. London, p. 1017.
Wilson—1928, Canadian Ent. LX, p. 27.

TABLE I.

Stages in the Development of *Columbicola columbae* (Linn.)

Egg Stage

Oviposited	Hatched	
12-26-32	12-29-32	3 days
1- 6-33	1-12-33	6 "
1- 5-33	1-13-33	8 "
1- 6-33	1-13-33	7 "
2-17-33	2-22-33	5 "
2-22-33	2-27-33	5 "
2-23-33	2-27-33	4 "
2-24-33	2-27-33	3 "
2-24-33	2-28-33	4 "
4-10-33	4-15-33	5 "
4-10-33	4-15-33	5 "
4-10-33	4-15-33	5 "
4-10-33	4-15-33	5 "
4-10-33	4-15-33	5 "
4-12-33	4-15-33	3 "
4-14-33	4-17-33	3 "
4-14-33	4-17-33	3 "
4-14-33	4-17-33	3 "
4-14-33	4-17-33	3 "
4-14-33	4-17-33	3 "
4-14-33	4-17-33	3 "
4-14-33	4-17-33	3 "
4-14-33	4-17-33	3 "
4-14-33	4-17-33	3 "
4-14-33	4-17-33	3 "
4-28-33	5- 3-33	5 "
		26|108.00
		4.15 average

Standard deviation: ±.78
Probable error.....: ±.103

First Instar

Hatched	First Molt	
12- 8-32	12-16-32	8 days
12-15-32	12-23-32	8 "
2-21-33	2-28-33	7 "
2-27-33	3- 9-33	10 "
3-14-33	3-18-33	4 "
3-14-33	3-19-33	5 "
3-16-33	3-20-33	4 "
3-16-33	3-20-33	4 "
3-17-33	3-22-33	5 "
3-16-33	3-23-33	7 "
3-16-33	3-23-33	7 "
3-22-33	3-29-33	7 "
3-29-33	4- 6-33	8 "
4- 7-33	4-14-33	7 "
4- 7-33	4-14-33	7 "
4- 8-33	4-14-33	6 "
4-17-33	4-24-33	7 "
4-17-33	4-24-33	7 "
4-17-33	4-24-33	7 "
4-17-33	4-24-33	7 "
4-17-33	4-24-33	7 "
4-17-33	4-24-33	7 "
4-17-33	4-24-33	7 "
4-17-33	4-24-33	7 "
4-17-33	4-24-33	7 "
4-17-33	4-25-33	8 "
4-18-33	4-25-33	7 "
		26|175.00
		6.73 average

Standard deviation: ±.58
Probable error.....: ±.076

Second Instar

First Molt	2nd Molt	
2-28-33	3- 6-33	6 days
3- 4-33	3-10-33	6 "
3- 6-33	3-13-33	7 "
3-23-33	3-29-33	6 "
3-28-33	4- 3-33	6 "
3-28-33	4- 3-33	6 "
3-28-33	4- 3-33	6 "
3-29-33	4- 6-33	8 "
4- 6-33	4-13-33	7 "
4- 8-33	4-15-33	7 "
4- 8-33	4-16-33	8 "
4-10-33	4-17-33	7 "
4-10-33	4-17-33	7 "
4-14-33	4-22-33	8 "
4-22-33	4-26-33	4 "
4-24-33	5- 1-33	7 "
4-24-33	5- 1-33	7 "
4-25-33	5- 3-33	8 "
		18|121.00
		6.72 average

Standard deviation: ±.4
Probable error.....: ±.064

Third Instar

Second Molt	Third Molt	
1-13-33	1-19-33	6 days
2-23-33	3- 3-33	8 "
2-23-33	3- 3-33	8 "
2-23-33	3- 3-33	8 "
2-28-33	3- 5-33	6 "
3- 6-33	3-13-33	7 "
3-23-33	3-28-33	5 "
3-29-33	4- 4-33	6 "
4- 4-33	4-10-33	6 "
4- 7-33	4-14-33	7 "
4-17-33	4-24-33	7 "
4-22-33	4-30-33	8 "
4-26-33	5- 1-33	5 "
		13|88.00
		6.77 average

Standard deviation: ±.13
Probable error.....: ±.025

Life Cycle from Hatching to Adult

First Instar

2-21-33	2-28-33	7 days
3-16-33	3-23-33	7 "
3-22-33	3-29-33	7 "

Second Instar

2-28-33	3- 6-33	6 days
3-23-33	3-29-33	6 "
3-29-33	4- 6-33	8 "

Third Instar

3- 6-33	3-23-33	7 days
3-29-33	4- 4-33	6 "
4- 6-33	4-14-33	8 "

TABLE II

Egg

Length	Width
.720	.210
.708	.204
.720	.186
.714	.198
.696	.204
.684	.210
.708	.204
.660	.204
.714	.192
.696	.198
av.-.702 mm.	av.-.201 mm.
Standard deviation: ±.016	±.0707
Probable error.....: ±.003	±.015

First Instar

Head	Thorax	Abdomen	Total
.270	.186	.348	.804
.276	.180	.396	.852
.258	.204	.408	.870
.276	.180	.348	.804
.270	.186	.408	.864
.216	.180	.378	.774
.270	.180	.354	.804
.264	.174	.360	.798
.288	.174	.372	.834
.300	.180	.366	.846
.270	.174	.378	.822
			av. .824 mm.
Standard deviation: ±.008			
Probable error.....: ±.001			

Second Instar

Head	Thorax	Abdomen	Total
.336	.228	.690	1.254
.324	.210	.618	1.152
.354	.228	.564	1.146
.348	.216	.696	1.360
.342	.234	.672	1.248
.336	.210	.660	1.206
			av. 1.227 mm.
Standard deviation: ±.04			
Probable error.....: ±.012			

Third Instar

Head	Thorax	Abdomen	Total
.450	.306	.912	1.668
.432	.330	.870	1.632
.438	.318	.960	1.714
.420	.258	.840	1.518
			av. 1.633 mm.
Standard deviation: ±.421			
Probable error.....: ±.166			

Male

Head	Thorax	Abdomen	Total
.522	.426	1.266	2.214
.522	.426	1.308	2.256
.534	.468	1.404	2.406
.510	.426	1.302	2.238
.534	.426	1.620	2.580
.504	.426	1.260	2.190
.522	.450	1.596	2.268
.546	.450	1.266	2.262
.450	.414	1.194	2.058
.504	.426	1.260	2.190
.504	.438	1.272	2.214

av. 2.289 mm.

Standard deviation: ±.109
Probable error.....: ±.023

Female

Head	Thorax	Abdomen	Total
.522	.456	1.806	2.814
.522	.426	1.650	2.628
.534	.390	1.578	2.502
.522	.426	1.692	2.640
.560	.408	1.632	2.600
.528	.414	1.638	2.580
.522	.450	1.710	2.682
.594	.450	1.800	2.844
.564	.414	1.686	2.664
.558	.426	1.650	2.634
.558	.462	1.764	2.814
.558	.432	1.686	2.676

av. 2.673 mm.

Standard deviation: ±.09
Probable error.....: ±.018

NOTES ON LEAFHOPPERS (HOMOPTERA, CICADELLIDAE)*

BY R. H. BEAMER.
Lawrence, Kansas.

Dikraneura rubens n. sp.

Externally resembling the species of Erythroneura with red dorsal stripe (*E. lawsoniana* Bk.) more than any member of its own genus. Easily separated from these of course by the submarginal vein and from all Dikraneura by the bright red or orange median dorsal stripe.

General ground color semi-hyaline to yellowish white. Vertex solid red or deep orange except a small angular spot on margin at anterior corner of each eye and sometimes a small indefinite spot either side middle near tip. Pronotum red except lateral margins, median spot on anterior margin and sometimes a median spot on posterior margin. Scutellum usually entirely red or orange. The stripe so far produced continues as a broad vitta occupying entire clavus except small spot at tip of scutellum and another at tip of clavus. Coria yellow to hyaline with red or orange band arising near middle of costal plaque, running parallel with claval suture and ending at cross-veins. Tips of tegmen cloudy. Face tinged with orange, other parts stramineous except ovipositor which is sometimes fuscous.

Holotype, male, *allotype*, female and numerous paratypes, Chiricahua Mts., Arizona, July 7, 1932, R. H. Beamer; 12 ♀ and 2 ♂ paratypes, Huachuca Mts.,

*Publication of the Department of Entomology, University of Kansas, Lawrence, Kansas.

Arizona, July 8, 1932. Types in Snow Entomological Collection, Lawrence, Kansas.

Alconeura dodonana n. sp.

Resembling *Alconeura quadrimaculata* Lawson, somewhat, but with many more orange markings, and a flattened face instead of arched.

General ground color yellowish white. Vertex with inverted V-shaped orange mark with arms of V broadened to touch eyes. Pronotum with inverted undulating W-shaped orange mark reaching both anterior and posterior margins. Scutellum all orange except small square anterio-mesal yellowish white spot. Clavi with large, almost circular, basal orange spot and an elongated bilobed mesal one. Coria with diagonal orange dash at anterior end of costal plaque ending in enlarged rounded area at claval suture; another slightly narrower and shorter diagonal dash at posterior end of costal plaque and an oval spot near its inner end. Cross veins light margined with fuscous. Small round black spot in base of cell M4. Venter stramineous suffused with orange. Tip of ovipositor often black.

Holotype, male and *allotype,* female, Sabino Canyon, Arizona, July 14, 1932, R. H. Beamer: 19 female and one male paratypes same data. One female paratype, Baboquivari Mts., Ariz., July 19, 1932, R. H. Beamer.

All specimens were collected on *Dodonaea viscosa* var. *angustifolia.*

Types in Snow Entomological Collection, Lawrence, Kansas.

Alconeura balli n. sp.

General ground color yellowish green mottled with lighter. Head conical, quite pointed with two slightly darker yellow marks or blotches near base. Pronotum with anterior border whitish yellow, lacking the mottling, remainder of pronotum mottled. Scutellum of about same color as anterior border of pronotum. Tegmen pale greenish yellow mottled with white to cross-veins. Usually pink to tip slightly suffused with fuscous. Black spot in base of cell M4. Venter dark throughout. Longitudinal veins white spotted, cross veins and apicals entirely white.

Vertex about as wide as long. Head narrower than pronotum. Pronotum with sides long and parallel. Length 2.25 mm.

Holotype, male and *allotype,* female, Santa Rita Mts., Arizona, July 17, 1932, R. H. Beamer. Numerous paratypes, same data.

Resembles superficially *Alconeura planata* Ball and DeLong but may easily be separated from that species by the pink tips of the tegmen.

Types in Snow Entomological Collection, Lawrence, Kansas.

Erythroneura apache Baker

Typhlocyba bipunctata Gillette, Proc. U. S. Nat. Mus., XX, 751; 1898.
Erythroneura apache Baker, Phil. Jour. Sci., XXVII, 537, 1925.
Erythroneura balli Beamer, Jour. Kans. Ent. Soc. V. (No. 4), 125, 1932.

Prof. E. P. Van Duzee called my attention to the fact that *Erythroneura balli* Beamer fits the description of *Erythroneura apache* Baker. A comparison by P. W. Oman of the U. S. N. Museum, of specimens of *E. balli* Beamer with the (wingless) female type of *E. apache* Baker settles fairly conclusively that this is the case. Therefore *E. balli* Beamer becomes a synonymy of *E. apache* Baker.

The following is the description of a male from Yarnell Hill, Arizona, which is here designated as the allotype of *Erythroneura apache* Baker:

General ground color, semihyaline to yellowish white, marked with red and brown. Vertex with two round velvety black spots, one on either side of median line, slightly nearer anterior margin, both surrounded by white band which are in turn separated by red mesal line. Remainder of vertex red. Pronotum red and white mottled with heavier angular red mark back of each eye. Scutellum with black spot in each basal angle surrounded by white band, remainder red.

Tegmina generally red, claval suture and longitudinal veins white. Apical cells, a basal dash on mesal margin of clavi and some dashes in longitudinal cells more or less dusky.

Venter yellowish more or less marked with red. Clypeus fuscous. Dorsum of abdomen dusky.

Summer specimens often have no red on vertex, pronotum or scutellum, and very little on tegmina.

Erythroneura accurata n. n.

New name for *Erythroneura pulchra* Beamer (nec. Naude).

The specific name *pulchra* was used for an African *Erythroneura* in 1926, (Ent. Mem. Dept. Agric. Pretoria, S. Africa) by T. G. Naude. I therefore suggest the name *Erythroneura accurata* for the North American species.

Typhlocyba hubbardi (McA.)

Erythroneura hubbardi McAtee, Fla. Ent., VIII, 35, 1924.

An examination of the wing venation of the female type of this species places it in the genus *Typhlocyba*. Many additional specimens from the type locality are at hand. There is some variation in the number of clear areoles and also in the sooty black parts, the anterior and posterior portions often mesally connected. A male agreeing with the female, taken in the Chiricahua Mts., Ariz., July 8, 1932, is here designated allotype.

THE DEVELOPMENT OF THE WINGS OF A CADDICE-FLY GLOSSOSOMA AMERICANUM

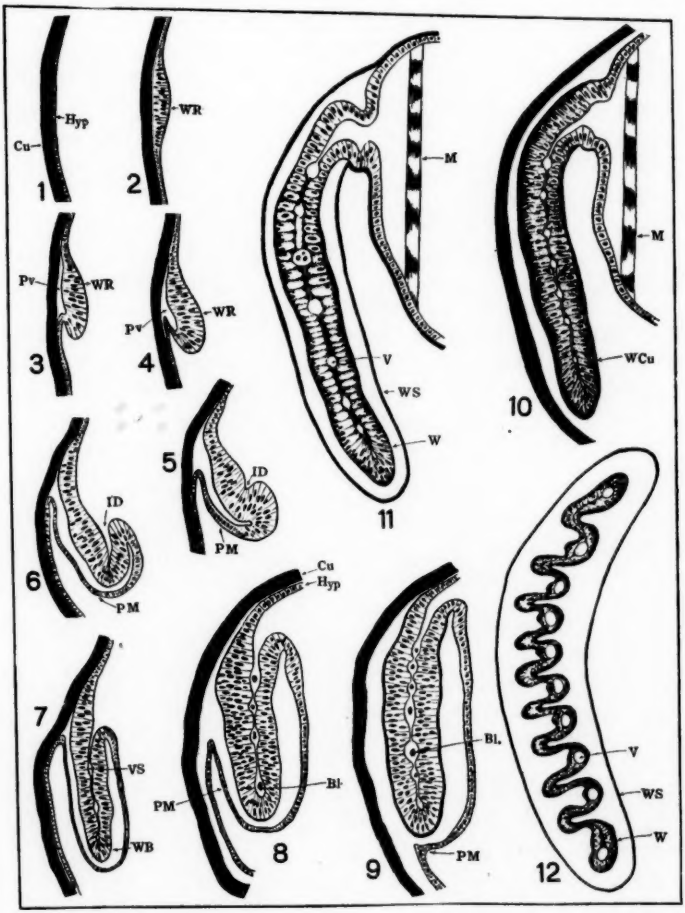
BY SHAO-WEN LING,
Cornell University, Ithaca, N. Y.

The development of wings from imaginal discs has been carefully worked out in many forms of insect larvae. Marshall's important paper on the development of the wings of a caddis-fly, *Hesperophylax* (*Platyphylax*) *designatus* Walk. (*Zeitschrift fur wissenschaftliche Zoologie*, Bd. CV, Heft 4, 1913) is almost the only literature dealing with this phenomenon in the Trichoptera. The rather generalized larvae of this order are favorable for such study, because the meso- and metathorax are not heavily scleritized and thus offer no difficulties in sectioning. This paper is offered for the sake of the accompanying plate, which illustrates more completely than has hitherto been done the form changes in internal wing development.

The caddis worm studied was *Glossosoma americanum* (Banks), a species of great abundance in the rocky streams around Ithaca, New York. All specimens used were collected from the upper part of Six-mile Creek during the months of October, November and April. They were brought in to the laboratory in

their own cases so as to avoid unnecessary injuries on the way. They were then removed from their cases and separated into groups according to size and condition.

The youngest larvae found, about 1.7 mm. in length, showed the cuticula and hypodermis the same everywhere throughout the whole thorax, with no wing rudiment yet appearing. The cuticula, as in other insects, consists of an outer primary and an inner secondary layer; for the sake of simplicity it will be represented in the figures by a broad solid black line. The hypodemis is thin with small not well defined cells and large nuclei and is highly pigmented throughout. (Fig. 1).



Larvae of about 2.5 mm. in length showed the first appearance of wing rudiments. The cells of the hypodermis at the sides of the middle part of meso- and metathorax thicken and elongate and take a deeper stain than the rest of the hypodermis. This thickened portion of the hypodermis is the beginning of the wing. It can easily be recognized by the greatly elongated cells, the large number of nuclei and the deep stain. The cuticula remains unchanged. (Fig. 2.)

Larvae of about 4 mm. in length show buds that increase in size and begin to separate from the cuticula and sink inward, thus forming a cavity beneath the cuticula, the *peripodial cavity*. The wing rudiment is spindle-shaped, convex on both surfaces and contains larger cells than the previous stage. The cells at the lower end of the rudiment grow faster and begin to sink inward. (Fig. 3.)

Larvae of about 5 mm. in length show that the lower end of the wing rudiment grows faster and definitely sinks in and carries the adjacent part of the hypodermis with it. The cells are more definite and contain more cytoplasm and larger nuclei than before. (Fig. 4).

In larvae of about 6.5 mm. in length the rudiment is no longer spindle-shaped. The lower end sinks inward deeper than before. The inner surface of the rudiment is distinctly notched. This notch is the beginning of the evagination which later will form the wing cavity in the imaginal disk. (Fig. 5.)

In larvae of about 7.5 mm. length the evagination extends and the lower end grows inward still further. (Fig. 6.)

In the full grown larvae the wing rudiment increases greatly in size. The two surfaces come close to each other. Veins spaces are formed. In this stage the double pocketing of the imaginal disc and the peripodial membrane is similar to that found in the larvae of Lepidoptera. (Fig. 7.)

In an early pre-pupal stage, when the larvae have ceased active life and have closed their cases preparatory to pupation, the wing bud continues increasing in length and width. More vein spaces form, and leucocytes are found in them. The peripodical membrane begins to break loose from the cuticula and sinks inward thus gradually exposing the wing bud on the outer side. (Fig. 8.)

In a pre-pupal stage about one day older than the preceding, the peripodial membrane has almost completely sunk down. A thin layer of cuticle begins to be formed on the surface of the wing bud. The cells of the bud begin to form vacuoles at their inner ends and the nuclei are moving toward the periphery, (Fig. 9.)

In an old pre-pupal stage, ready for transformation to the pupa, the wing bud is entirely external in position except that it is still covered by the old larval skin. The cells of the wing-bud have become even more vacuolated at the inner end and their nuclei have migrated almost to the very periphery. The peripodial membrane has been completely drawn in to form the new pupal body wall. (Fig. 10.)

Young pupae, newly transformed from the larvae and fresh and yellowish in color, show no great differences from the preceding except that the larval skin is gone and the wing buds now hang on the outside. The cuticle secreted by the wing bud is loosened and detached from it, forming a complete enveloping sac. (Fig. 11.)

An examination of some whole mounts of the wing buds at this stage shows that there is only one tracheal trunk in the wing bud. This tracheal tube runs longitudinally along the upper margin of the radial vein. From it some smaller branches come off and invade all parts of the wing but have no relation whatsoever with the veins. This agrees with what was found in *Hesperophylax designatus* by Marshall.

In old pupae with wing pads already blackened the wing buds have greatly increased in length and width by compressing and stretching the cells. Since the wing bud is confined in the cuticula sac which has a limited space, increase of surface can only be accomplished by folding. Therefore the cross-section at this stage shows that the wing is folded in a fan-like fashion within the cuticula sac. All the veins lie in the concavities of the foldings as shown in fig. 12.

ABBREVIATIONS.

Bl—Blood cell; Cu—Cuticula; Hyp—Hypodermis; ID—Imaginal disc; M—Muscle; PCu—Pupal cuticula; PM—Peripodial membrane; Pv—Peripodial cavity; W—Wing; WB—Wing bud;; WCu—Wing-bud cuticula; WR—Wing rudiment; Ws—Wing sac; V—Vein; VS—Vein space.

A NEW MELYRID FROM MEXICO (COLEOPTERA, MELYRIDAE).

BY HOWARD E. HINTON,
Berkeley, California.

The genus *Cymbolus* Gorham is peculiar to the American tropics. Of the five previously described species, two are from Mexico, two are from Guatemala, and the fifth is from Brazil. I take great pleasure in naming the following species in honor of Mr. A. B. Wolcott through whose efforts I first became interested in the study of this genus.

Cymbolus wolcotti n. sp.

Elongate, broad, shining; elytra and pronotum brown with an aeneous lustre, clothed with moderately dense, long, soft, brownish pubescence, head, eyes, and ventral surface black, shining, legs and mouthparts ferruginous. Head sparsely, moderately coarsely punctate; eyes large, transverse, coarsely faceted; antennae short, reaching a little beyond base of elytra, segments four to ten serrate. Prothorax nearly twice as wide as long, punctures with raised margins, small, irregularly dispersed with eleven irregular, polished callosities placed as follows; five central, two on each side of these, and one near the middle of the lateral margin; basal margin feebly sinuate in front of humeri, basal angles obtuse; sides rounded, narrowing from a little before the base, margins crenulate; anterior margin feebly sinuate behind eyes, anterior angles obtuse. Elytra widest at apical one-third, extremely coarsely, densely punctate; submarginal ridge broad and bordered within by a row of slightly coarser punctures; scutellum clothed with paler and more fulvous hairs. Body beneath black, sparsely clothed with fulvous pubescence, sparsely, shallowly punctured, irregularly, minutely rugulose; second ventral abdominal segment longer than the basal segment. Legs sparsely clothed with long, soft pubescence. Length 5 mm., breadth 2.75 mm.

Holotype (No. 3751, Mus. Calif. Acad. Sci.), collected on June 9, 1933, and three paratypes collected on July 13, 1933, on *Pinus pseudostrobus* Lindley, at Real de Arriba, District of Temascaltepec, Mexico, by Mr. R. L. Usinger and the writer. One of the paratypes is deposited in the collection of Mr. A. B. Wolcott.

This species is probably most closely related to *Cymbolus punctipennis* Gorh., but it differs from this species and the other known species in its black head, black antennae, and entirely black ventral surface.

Cymbolus elongatus Champ.

Champion, Trans. Ent. Soc. Lond. 1913, p. 128.

Three specimens of this interesting little beetle were taken by the writer

in July, 1932, and a series of thirty-six specimens were collected by Mr. R. L. Usinger and the writer in June 1933, at Tejupilco, District of Temascaltepec, Mexico, at an elevation of 3960 feet. All examples were beaten from species of *Mimosa* and *Spondias*.

NEW SPECIES OF COLEOPTERA V*.

BY W. J. BROWN,
Ottawa, Ontario.

Cicindela sexguttata denikei n. subsp.

Male. Length 13.9 mm. Body olivaceous green as in the subspecies *harrisii* Leng, elytra immaculate.

Female. Length 14 mm. Color as in the male but with the middle band of each elytron represented by a very small, circular, submarginal spot; the apical lunule represented by a smaller spot.

Holotype— ♂, Ingolf, Ont., (W. N. Denike); No. 3529 in the Canadian National Collection, Ottawa.

Allotype— ♀, same data, July 21, 1932.

Paratypes—9 ♂, 5 ♀, same locality, various dates in July and August (W. N. Denike, J. B. Wallis, and H. E. Chaplin).

The paratypes measure from 12.6 to 15.3 mm. Six of them are immaculate; three are spotted like the allotype; five have on each elytron only the spot representing the middle band. Most of the paratypes show faint bluish reflections and one female is strongly bluish.

This race is characterized by its large size, reduced maculation, and the color which is a rather dark, dull green as in *harrisii*. I have before me forty-nine examples of the common eastern form of *sexguttata*, collected in Eastern Ontario, Quebec, and adjacent states, and nine examples of *harrisii*. In all of these, the elytral spots are larger and the anteapical spot is very distinct. The present subspecies resembles more closely the subspecies *tridens* Csy. in which the maculation is reduced, but in the latter the size is smaller and the color is a brighter green.

According to Mr. J. B. Wallis, who has submitted the subspecies to me for description, *denikei* occurs in rocky situations.

Enicmus tricarinatus n. sp.

Length 1.8 mm. Pale reddish-yellow, the head and prothorax slightly darker. Head as long as its width across the tempora, the width including the eyes equal to the width of the pronotal base; roughly sculptured by coarse, close punctures, without trace of a median sulcus. Eyes unusually small, equal to the tempora in length. Antennae extending to the basal impressions of pronotum; the segments of the clubs all longer than wide, the tenth segments only slightly so.

Pronotum shaped as in *consimilis* Mann. but less strongly transverse, its length equal to four-fifths the width; widest near the anterior angles, the sides almost straight and converging feebly to base; the basal angles right; the anterior angles feebly lobed. Disk sculptured like the head, the transverse impression broadly interrupted at middle; without a median impression but with a very fine, rather indistinct carina on each side of the median line in basal half.

*Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa.

Elytra moderately elongate as in *consimilis,* the side margins broadly explanate as in *minutus* L.; second, fourth, and sixth intervals flat, distinctly wider than the strial punctures; the third, fifth, and seventh intervals subequal in width to the punctures, elevated from base to apex, the third costate, the fifth and seventh strongly carinate.

Prosternal process not elevated above the plane of the epimera. Metasternum impunctate, with rugae radiating from deep, post-coxal foveae. Abdomen impunctate, without rugae. Sexual characters not evident.

Holotype—Saskatoon, Sask., May 20, 1926, (K. M. King); No. 3649 in the Canadian National Collection, Ottawa.

Paratypes—2 specimens, same data.

The paratypes measure 2 mm. The species agrees well with *consimilis* in body form except that the pronotum is much more strongly transverse in the latter. The present species may be known by the form of the elytral intervals; the very small eyes and the strongly depressed prosternal process are unusual characters.

Ochrosidia knobelae n. sp.

Male. Length 9 mm.; width 5 mm., the body short, robust as in *nigricollis* Burm. Color and vestiture of dorsum as in *nigricollis,* the head blackish, the clypeus rufous; pronotum and elytra reddish brown, the former with median line narrowly and the sides broadly reddish-yellow; all these parts except the clypeus clothed with long, sparse, yellow hairs. Pygidium and venter clothed with similar hairs but, like the legs, testaceous in color, without a rufous cast.

Front and clypeus coarsely and closely punctate, the punctures of the vertex fine and sparse. Clypeus semicircular in form, its width measured on the suture twice the length of its median line, its side margins very feebly reflexed, the apical margin more broadly and strongly reflexed and distinctly thickened. Antenna as in *nigricollis.* Maxillary palpus short and stout, the penultimate segment not quite twice as long as wide, the ultimate segment about three and one-half times as long as wide. Labium as in *nigricollis.*

Pronotum two-thirds as long as wide; coarsely, sparsely, and irregularly punctate; the basal marginal line broadly interrupted at middle. Elytra, pygidium, and legs, except for color, as in *nigricollis.*

Female. More robust and convex than the male; the dorsum including the pygidium glabrous; the eyes, antennae and legs modified as in *nigricollis.* Clypeus as in the male but with the thickened anterior margin more prominent, as in the female of *nigricollis* but lacking the acute edge which limits the clypeal thickening in the latter. Maxillary palpus stouter and shorter, the penultimate segment slightly longer than wide, the ultimate segment two and one-half times as long as wide as in the female of *nigricollis.*

Holotype—♂, Hope, Arkansas, (Louise Knobel); No. 3528 in the Canadian National Collection, Ottawa.

Allotype—♀, same data.

Paratypes—1 ♂, 1 ♀, same data.

The paratypes measure 9 and 10 mm. in length and have all the dorsal parts paler in color. In the male only the apical tooth of the anterior tibia is developed. The species belongs to Mr. Buchanan's section C of the genus (1927,

Ent. News, XXXVIII, 167) and resembles in appearances *nigricollis* Burm. and *subvittata* Brown, the other species of the group. In the color of the pronotum and elytra, the present species resembles *nigricollis*, in which, however, the pygidium, venter, and legs are rufous. In *subvittata* the legs and venter are yellow as in *knobelae*, but the pygidium is darker than any other body part except the front. In pronotal form, *knobelae* agrees with *subvittata*; in *nigricollis* the pronotum is a little shorter, three-fifths as long as wide, and has the side margins a little more strongly arcuate. In the males of *nigricollis* and *subvittata*, the clypeus is rectangular, as figured for the former by Mr. Buchanan, and the maxillary palpi are much more elongate, the length of the penultimate segment being two and one-half times its width and of the ultimate five times its width. The present species is the smallest of the group.

In these three species, the prosternum is tumid behind the coxae but is not produced to form an elongate process as in the other sections of *Ochrosidia* and in the allied generea.

Date of Mailing, February 3, 1934.

1934

. and
notum
pygi-
ellow
front.
notum
little
eus is
illary
g two
resent

out is
osidia